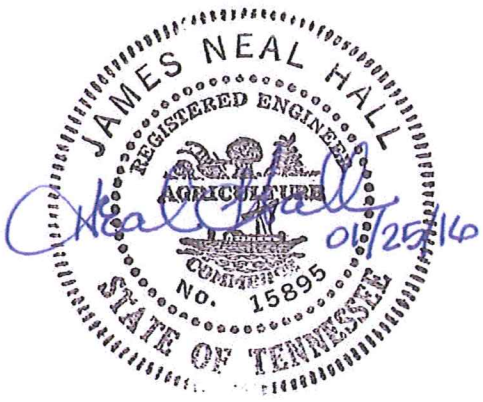
TECHNICAL SPECIFICATIONS AND PLANS

CARROLL LAKE DRAIN REHABILITATION

PREPARED FOR

TENNESSEE WILDLIFE RESOURCES AGENCY



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SECTION 05 5000

METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following metal fabrications:

1. Radial Gates
2. Debris Screen
3. Debris Screen Frame

1.2 RELATED DOCUMENTS

A. Drawings of the Project apply to work of this section.

1.3 SUBMITTALS

A. General. Submit the following items.

B. Product data for products used in miscellaneous metal fabrications, including paint products and grout.

C. Shop drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other sections.

1. Where installed metal fabrications are indicated to comply with certain design loadings, include structural computations, material properties, and other information needed for structural analysis that has been signed and sealed by the qualified professional engineer who was responsible for their preparation.

D. Welder certificates signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" article.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications. Firm experienced in successfully producing metal fabrications similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the work.

B. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel," D1.3 "Structural Welding Code -Sheet Steel," and D1.2 "Structural Welding Code - Aluminum."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

C. Engineer Qualifications. Professional engineer licensed to practice in jurisdiction where Project is located and experienced in providing engineering services of the kind indicated that have resulted in the successful installation of metal fabrications similar in material, design, and extent to that indicated for this Project.

1.5 PROJECT CONDITIONS

A. Field Measurements. Check actual locations of walls and other construction to which metal fabrications must fit, by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of work.

1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabrication of products without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

PART 2 - PRODUCTS

2.1 FERROUS METALS

A. Metal Surfaces, General. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher-leveled sheet.

B. Steel Shapes

1. W Shapes. ASTM A 992.

2. C and S Shapes. ASTM A 36.

3. CEE and ZEE (purlins and girts). ASTM A 570 Grade 33 (min).

C. Steel Plates, Angles, and Bars. ASTM A 36.

D. Rolled Steel Floor Plates. ASTM A 786.

E. Steel Bars for Gratings. ASTM A 569 or ASTM A 36.

F. Wire Rod for Grating Cross Bars. ASTM A 510.

G. Cold-Formed Steel Tubing. ASTM A 500; Grade B, unless otherwise indicated or required for design loading.

H. Galvanized Steel Sheet. ASTM A 653; Grade A, unless another grade required for design loading, and G90 coating designation unless otherwise indicated.

I. Steel Pipe. ASTM A 53; finish, type, and weight class as follows:

1. Galvanized finish for exterior installations and where indicated.

2. Type S, Grade B, standard weight (Schedule 40), unless otherwise indicated, or another weight required by structural loads.

J. Gray Iron Castings. ASTM A 48, Class 25 or better.

K. Welding Rods and Bare Electrodes. Select in accordance with AWS specifications for the metal alloy to be welded.

2.2 STAINLESS STEEL

A. Bar Stock and Shapes. ASTM A 276, Type 304 or 316.

B. Plate. ASTM A 240, Type 304 or 316.

C. Bolts and Nuts. ASTM F 593 and ASTM F 594, Type 304 or 316.

2.3 GROUT

A. Nonshrink Nonmetallic Grout. Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with CE CRD-C 621. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this section.

B. Available Products. Subject to compliance with requirements, non-shrink nonmetallic grouts that may be incorporated in the work include but are not limited to the following:

1. "Bonsal Construction Grout," W. R. Bonsal Co.
2. "Diamond-Crete Grout," Concrete Service Materials Co.
3. "Euco N-S Grout," Euclid Chemical Co.
4. "Kemset," Chem-Masters Corp.
5. "Crystex," L&M Construction Chemicals, Inc.
6. "Masterflow 713," Master Builders.
7. "Sealtight 588 Grout," W. R. Meadows, Inc.
8. "Sonogrout," Sonneborn Building Products Div., Rexnord Chemical Products, Inc.
9. "Stonecrete NM1"; Stonhard, Inc.
10. "Five Star Grout," U. S. Grout Corp.
11. "Vibropruf #11," Lambert Corp.

2.4 FASTENERS

A. General. Provide zinc-coated steel fasteners unless otherwise indicated. Select fasteners for the type, grade, and class required.

B. Connectors and Accessories

1. High Strength Bolts: ASTM A 325.
2. Unfinished Bolts: ASTM A 307, Grade B, cadmium plated.
3. Self-Locking Nuts: Prevailing torque type; IFI-100, Grade A.
4. Flat Washers: ANSI B 27.2.
5. Lock Washers: Spring type, ANSI B 27.1.
6. Beveled Washers: Table 1 of "Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts," AISC Steel Construction Manual.

C. Connection Requirements

1. Make connections not specifically detailed on Drawings using Tables I and III, Framed Beam Connections, in the latest edition of the AISC manual. The shop fabricated portion of structural connections may be bolted, welded, or riveted. Except for connections detailed on the Drawings or specified otherwise, make all field connections with ASTM A 325 high-strength bolts.

2. Connections for miscellaneous metal work not included in the AISC definition of structural steel may be made with unfinished bolts. All unfinished bolts shall be equipped with self-locking nuts or lock washers.

3. Install high-strength bolts using turn-of-nut tightening as described in "Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts" as set forth in the AISC manual. Beveled washers shall be used when the bearing faces of bolted parts have a slope of 1:20 or greater with respect to a plane perpendicular to the bolt axis. Provide a platform or other means of access at each field connection until the connection has been inspected by the Engineer.

4. Field welded connections will not be acceptable for structural steel unless shown on the Drawings or specifically permitted by the Engineer. Where structural or miscellaneous steel connections are welded, all butt and miter welds shall be continuous and where exposed to view shall be ground smooth. In addition, intermittent welds shall have an effective length of at least 2 inches and shall be spaced not more than 6 inches apart.

D. OSHA Standards. Connections shown on the Drawing or as specified in this or related sections indicate the details pertinent to performance of the structure or assembly. When erection means and methods dictate installation of additional temporary bolts or additional temporary bracing in order to adhere to OSHA regulations, the additional bolts and bracing shall be at the expense of the Contractor. Additional bolts and bracing shall be removed when permissible in the erection process and damaged areas repaired unless permitted by the Engineer to remain in place.

2.5 ANCHORAGE TO HARDENED CONCRETE

A. Dowels or anchors placed in existing or hardened concrete shall be stainless steel Type 316, ASTM F 593 and ASTM F 594, threaded rod with hex nuts, unless shown otherwise.

B. Epoxy Adhesive

1. Two component, 100% solid (containing no solvents), non-sag paste, insensitive to moisture, grey in color.
2. NSF Standard 61 for use in conjunction with drinking water systems.
3. ASTM C 881-90; Type IV; Grade 3; Class A, B, and C with the exception of gel time.
4. Maximum shrinkage during cure per ASTM D 2566 of 0.00051 in./in.
5. Compressive strength, ASTM D 695: 10,300 psi minimum.
6. Shelf life: 3 years minimum.
7. Water solubility: None.
8. Heat deflection temperature, ASTM D648: 140°F minimum.
9. Epoxy adhesive shall be Epcon C-6, manufactured by ITW Ramset.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.2 FABRICATION, GENERAL

A. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.

B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

C. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.

1. Temperature Change (Range): 100 F (55.5 C).

D. Shear and punch metals cleanly and accurately. Remove burrs.

E. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

F. Remove sharp or rough areas on exposed traffic surfaces.

G. Weld corners and seams continuously to comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.

H. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.

J. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

K. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware, screws, and similar items.

L. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

3.3 INSTALLATION, GENERAL

A. Fastening to In-Place Construction. Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.

B. Cutting, Fitting, and Placement. Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete masonry or similar construction.

D. Fit exposed connections accurately together to form hairline joints. Weld or bolt, as indicated, connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

E. Field Welding. Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.

F. Epoxy Anchors

1. Verify number, size, depth, and location of anchors or dowels to be installed.

2. Comply with temperature and moisture limitation as recommended by the manufacturer.

3. Drill holes in concrete to the depth specified on the Drawings using methods as instructed by the epoxy manufacturer. The diameter of holes shall be as instructed by the epoxy manufacturer for the anchor or dowel being installed. Clean holes as instructed by the epoxy manufacturer.

4. Install epoxy in strict accordance with the manufacturer's instructions using guns with self-mixing nozzles provided by the manufacturer. Verify epoxy is mixed prior to placement into the hole using methods per manufacturer's instructions. Insert dowel or anchor into the hole and hold steady as instructed by the manufacturer.

END OF SECTION

SECTION 05 5010

ALUMINUM STOP LOGS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, equipment and incidentals required to install and ready for operation aluminum stop logs, guide frames and stop log lifters as shown on the Contract Drawings and as specified herein.

1.2 SUBMITTALS

A. Provide the following information to confirm compliance with the specification.

1. Complete description of all materials including the material thickness of all structural components of the stop logs, guide frames and stop log lifter.

2. Installation drawings showing all details of construction, details required for installation, dimensions and anchor bolt locations.

3. Maximum bending stress and deflection of the stop logs under the maximum design head.

4. The location of the company headquarters and the location of the principle manufacturing facility. Provide the name of the company that manufactures the equipment if the supplier utilizes an outside source.

1.3 QUALITY ASSURANCE

A. Qualifications

5. All of the equipment specified under this Section shall be furnished by a single manufacturer with a minimum of 20 years experience designing and manufacturing stop logs. The manufacturer shall have manufactured stop logs for a minimum of 100 projects.

6. The specification is based on the Series 509-511 Aluminum Stop Log as manufactured by Whipps, Inc. of Athol, Massachusetts. Other acceptable manufacturers include Fontaine and Waterman.

PART 2 - EQUIPMENT

2.1 GENERAL

A. Stop log assemblies shall be as specified herein and have the characteristics and dimensions shown on the Plans.

B. Leakage shall not exceed 0.05 gpm/ft of wetted seal perimeter.

C. The stop logs shall be provided with a continuous resilient seal along the bottom and both sides. The guide frames shall not incorporate seals.

D. Stop logs shall be of the height as shown in the Contract Drawings and they shall be designed to function properly when stacked in any order.

E. Stop logs shall be designed to drop into place under their own weight without any downward pressure necessary. Stacking stop plates are not acceptable in lieu of stop logs.

F. All structural components of the stop logs shall be fabricated of aluminum and shall have adequate strength to prevent distortion during normal handling, during installation and while in service.

G. All structural components of the guide frames shall be fabricated of aluminum and shall have adequate strength to prevent distortion during normal handling, during installation and while in service.

H. All welds shall be performed by welders with AWS certification.

I. Finish: Mill finish on aluminum and stainless steel. All aluminum in contact with concrete shall be shop coated with a heavy coat of bitumastic paint. Welds on aluminum shall be cleaned to provide a uniform finish.

J. Materials:

Components	Materials
Frame Guides and Invert	6061-T6 Aluminum
Stop Logs	6061-T6 Aluminum
Lip Seal	Urethane, EPDM or Neoprene ASTM D-2000
Anchor Studs, Fasteners and Nuts	Stainless Steel, Type 316, ASTM A276

2.2 FRAME GUIDES

A. The frame guides or grooves and invert member shall be constructed of extruded aluminum with a minimum thickness of 1/4-inch.

1. Frame design shall allow for embedded mounting or mounting directly to a wall with stainless steel anchor bolts and grout. Mounting style shall be as shown on the Plans.

2. An invert member shall be provided across the bottom of the guides. The invert member shall be of the flushbottom type.

3. Frame mounted seals are not acceptable.

2.3 STOP LOGS

A. The stop logs shall be constructed of extruded aluminum shapes with a minimum thickness of 5/16-inch.

1. Furnish two (2) stop logs: one (1) 12-inches tall and one (1) 15-inches tall.

2. Maximum bending stress shall not exceed 7600 psi at the maximum operating head.

3. Adequate drainage shall be provided for each stop log.

4. Two slots shall be provided in the top of each stop log for removal and installation via the stop log lifter.

5. Each stop log shall be outfitted with an identification tag indicating the manufacturer, width of the opening and maximum head rating at a minimum. Additional tags shall be included on each stop log that indicate "dry side" and "wet side". Tags shall be welded to each log.

2.4 SEALS

A. Each stop log shall be outfitted with a continuous resilient lip seal along the bottom and both sides to restrict leakage in accordance with the requirements listed in this specification.

1. The continuous lip seal shall be constructed of urethane or rubber and shall be mechanically retained to the stop log.

2. The lip seal shall be activated by a combination of the weight of the stop log and the differential water pressure, which pushes the seal against the inside of the groove assembly.

3. Stop logs that utilize rubber "J" seals or "P" seals are not acceptable.

2.5 LIFTER

A. One stop log lifter shall be provided.

1. The lifter shall be constructed of aluminum and shall be outfitted with UHMW guide bars and stainless steel fasteners.

2. The lifter shall be provided with lifting hooks designed to engage the slots in the top of the stop logs. A lanyard release will be incorporated into the design.

3. The lifter shall be capable of installing and removing all stop logs of the same width whether they are installed or at the operating floor level.

2.6 HOIST

A. Furnish portable hoist for removal and installation of stop logs. Hoist shall have a permanent base mounted on the service spillway structure.

B. Hoist capacity shall be rated at least double the force required to lift submerged stop log.

C. Hoist shall be 3/16" stainless steel cable, hand winch with cut spur gears, large diameter drum and disc brake.

2.7 ANCHOR BOLTS

A. Anchor bolts shall be provided by the stop log manufacturer for mounting the guide frames.

1. Quantity and location shall be determined by the stop log manufacturer.

2. If epoxy type anchor bolts are provided, the stop log manufacturer shall provide the studs and nuts.

3. Anchor bolts shall have a minimum diameter of 1/2-inch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation of the stop logs, guide frames and appurtenances shall be done in a workmanlike manner. It shall be the responsibility of the CONTRACTOR to handle, store and install the equipment specified in this Section in strict accordance with the manufacturer's recommendations.

B. The CONTRACTOR shall review the installation drawings and installation instruction prior to installing the guide frames.

C. The guide frames shall be installed in a true vertical plane, square and plumb.

D. The CONTRACTOR shall fill the void in between the guide frames and the wall with non-shrink grout as shown on the installation drawing and in accordance with the manufacturer's recommendations.

3.2 FIELD TESTING

A. After installation, all stop logs shall be field tested in the presence of the OWNER to ensure that all items of equipment are in full compliance with this Section. The stop logs shall be inserted into the guide frames to confirm that they operate in accordance with the specification.

END OF SECTION

SECTION 05 5020

STAINLESS STEEL GATES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, equipment and incidentals required to install, ready for operation and field test stainless steel gate and appurtenances as shown on the Plans and as specified herein.

B. The gate and appurtenances shall be supplied in accordance with the latest edition of AWWA C561 Standard for Fabricated Stainless Steel Slide Gates as modified herein. The allowable leakage rate for the stainless steel gates in this specification shall be 1/2 the allowable leakage listed in the latest revision of AWWA C561.

1.2 SUBMITTALS

A. Provide the following information.

1. Complete description of all materials including the material thickness of all structural components of the frame and slide.

2. Installation drawings showing all details of construction, details required for installation, dimensions and anchor bolt locations.

3. Maximum bending stress and deflection of the slide under the maximum design head.

1.3 QUALITY ASSURANCE

A. Qualifications

1. All of the equipment specified under this Section shall be furnished by a single manufacturer with a minimum of 20 years experience designing and manufacturing water control gates. The manufacturer shall have manufactured water control gates for a minimum of 100 projects.

2. The specification is based on the 900 Series Stainless Steel Gate as manufactured by Whipps, Inc. of Athol, Massachusetts. Other acceptable manufacturers include Fontaine and Waterman.

PART 2 - EQUIPMENT

2.1 GENERAL

A. Gate shall be as specified herein and have the characteristics and dimensions shown on the Plans.

B. Leakage shall not exceed 0.05 gpm/ft of wetted seal perimeter in seating head and unseating head conditions.

C. The gate shall utilize self-adjusting seals. Due to the difficulty of accessing gates when they are in service, gates that utilize adjustable wedges, wedging devices or pressure pads are not acceptable.

D. All structural components of the frame and slide shall be fabricated of stainless steel having a minimum thickness of 1/4-inch and shall have adequate strength to prevent distortion during normal handling, during installation and while in service.

E. All welds shall be performed by welders with AWS certification.

F. Finish: Mill finish on stainless steel. Welds shall be sandblasted to remove weld burn and scale. All iron and steel components shall be properly prepared and shop coated with a primer.

G. Materials:

Components	Materials
Frame Assembly and Retainers	Stainless Steel, Type 304L, ASTM A240
Slide and Stiffeners	Stainless Steel, Type 304L, ASTM A240
Stem	Stainless Steel, Type 304, ASTM A276
Fasteners, Nuts and Bolts	Stainless Steel, Type 304, ASTM A276
Invert Seal (Upward Opening Gates Only)	Neoprene ASTM D-2000 or EPDM
Seat/Seals and Facing	Ultra-High Molecular Weight Polyethylene ASTM D4020
Lift Nuts	Bronze ASTM B584
Pedestals and Wall Brackets	Stainless Steel, Type 304L, ASTM A276
Operator Housing	Cast aluminum or ductile iron

2.2 FRAME

A. The frame assembly, including the guide members, invert member and yoke members, shall be constructed of formed stainless steel plate with a minimum thickness of 1/4-inch.

1. Frame design shall allow for mounting directly to a wall with stainless steel anchor bolts and grout. Mounting style shall be as shown on the Plans.

2. All wall mounted or wall thimble mounted gates shall have a flange frame. Flat frame gates are not acceptable.

3. The structural portion of the frame that incorporates the seat/seals shall be formed into a one-piece shape for rigidity. Guide members that consist of two or more bolted structural members are not acceptable. Guide member designs where water loads are transferred through the assembly bolts are specifically not acceptable.

4. Gussets shall be provided as necessary to support the guide members in an unseating head condition. The gussets shall extend to support the outer portion of the guide assembly and shall be positioned to ensure that the load is transferred to the anchor bolts.

5. The frame shall extend to accommodate the entire height of the slide when the slide is in the fully opened position on upward opening gates or downward opening weir gates.

6. On self-contained gates, a yoke shall be provided across the top of the frame. The yoke shall be formed by two structural members affixed to the top of the side frame members to provide a one-piece rigid assembly. The yoke shall be designed to allow removal of the slide.

7. A rigid stainless steel invert member shall be provided across the bottom of the opening. The invert member shall be of the flushbottom type on upward opening gates.

8. A rigid stainless steel top seal member shall be provided across the top of the opening on gates designed to cover submerged openings.

2.3 SLIDE

A. The slide and reinforcing stiffeners shall be constructed of stainless steel plate. All structural components shall have a minimum thickness of 1/4-inch.

1. The slide shall not deflect more than 1/360 of the span or 1/16 inch, whichever is smaller, under the maximum design head.

2. Reinforcing stiffeners shall be welded to the slide and mounted horizontally. Vertical stiffeners shall be welded on the outside of the horizontal stiffeners for additional reinforcement.

3. The stem connector shall be constructed of two angles or plates. The stem connector shall be welded to the slide. A minimum of two bolts shall connect the stem to the stem connector.

2.4 SEALS

A. All gates shall be provided with a self-adjusting seal system to restrict leakage in accordance with the requirements listed in this specification.

1. All gates shall be equipped with UHMW polyethylene seat/seals to restrict leakage and to prevent metal to metal contact between the frame and slide.

2. The seat/seals shall extend to accommodate the 1-1/2 x the height of the slide when the slide is in the fully closed or fully opened position.

3. All upward opening gates shall be provided with a resilient seal to seal the bottom portion of the gate. The seal shall be attached to the invert member or the bottom of the slide and it shall be held in place with stainless steel attachment hardware.

4. The seal system shall be durable and shall be designed to accommodate high velocities and frequent cycling without loosening or suffering damage.

5. All seals must be bolted or otherwise mechanically fastened to the frame or slide. Arrangement with seals that are force fit or held in place with adhesives are unacceptable.

6. The seals shall be mounted so as not to obstruct the water way opening.

7. Gates that utilize rubber "J" seals or "P" seals are not acceptable.

8. The seal system shall have been factory tested to confirm negligible wear (less than 0.01") and proper sealing. The factory testing shall consist of an accelerated wear test comprised of a minimum of 25,000 open-close cycles using a well-agitated sand/water mixture to simulate fluidized grit.

2.5 STEM

A. A threaded operating stem shall be utilized to connect the operating mechanism to the slide. On rising stem gates, the threaded portion shall engage the operating nut in the manual operator.

1. The threaded portion of the stem shall have a minimum outside diameter of 1-1/2 inches. Stem extension pipes are not acceptable.

2. The stem shall be constructed of solid stainless steel bar for the entire length, the metal having a tensile strength of not less than 90,000 psi for stems that are 3 inches or less in diameter. Stems that are in excess of 3 inches in diameter shall have a tensile strength of 85,000 psi.

3. The stem shall be threaded to allow full travel of the slide.

4. Maximum L/R ratio for the unsupported part of the stem shall not exceed 200.

5. In compression, the stem shall be designed for a critical buckling load caused by a 40 lb effort on the crank or handwheel with a safety factor of 2, using the Euler column formula.

6. The stem shall be designed to withstand the tension load caused by the application of a 40 lb effort on the crank or handwheel without exceeding 1/5 of the ultimate tensile strength of the stem material.

7. The threaded portion of the stem shall have machine rolled threads of the full Acme type with a 16 microinch finish or better. Stub threads are not acceptable.

8. Stems of more than one section shall be joined by stainless steel or bronze couplings. The coupling shall be bolted to the stems.

9. Stems, on manually operated gates, shall be provided with adjustable stop collars to prevent over closing of the slide.

2.6 STEM GUIDES

A. Stem guide shall be provided when necessary to ensure that the maximum L/R ratio for the unsupported part of the stem is 200 or less.

1. Stem guide brackets shall be fabricated of stainless steel and shall be outfitted with UHMW or bronze bushings.

2. Stem guide shall be adjustable in two directions.

2.7 MANUAL OPERATORS

A. Gate shall be operated by a manual handwheel. The operator shall be mounted on the yoke of self contained gates or on the pedestal of non-self contained gates.

1. The gate manufacturer shall select the proper gear ratio to ensure that the gate can be operated with no more than a 40 lb effort when the gate is in the closed position and experiencing the maximum operating head.

2. An arrow with the word "OPEN" shall be permanently attached or cast onto the operator to indicate the direction or rotation to open the gate.

3. Handwheel operators shall be fully enclosed and shall have a cast aluminum housing.

a. Handwheel operators shall be provided with a threaded cast bronze lift nut to engage the operating stem.

b. Handwheel operators shall be equipped with roller bearings above and below the operating nut.

c. Positive mechanical seals shall be provided above and below the operating nut to exclude moisture and dirt and prevent leakage of lubricant out of the hoist.

d. The handwheel shall be removable and shall have a minimum diameter of 15 inches.

4. Pedestal shall be constructed of stainless steel. Aluminum pedestals are not acceptable.

a. The pedestal height shall be such that the handwheel or pinion shaft on the crank-operated gearbox is located approximately 36-in above the operating floor.

b. The design and detail of the brackets and anchor bolts shall be provided by the gate manufacturer and shall be approved by the Owner. The gate manufacturer shall supply the bracket, anchor bolts and accessories as part of the gate assembly.

5. Operator shall be equipped with fracture-resistant clear butyrate or lexan plastic stem covers.

   a. The top of the stem cover shall be closed.

   b. The bottom end of the stem cover shall be mounted in a housing or adapter for easy field mounting.

   c. Stem covers shall be complete with indicator markings to indicate gate position.

2.8 ANCHOR BOLTS

A. Anchor bolts shall be provided by the gate manufacturer for mounting the gates and appurtenances.

   1. Quantity and location shall be determined by the gate manufacturer.

   2. If epoxy type anchor bolts are provided, the gate manufacturer shall provide the studs and nuts.

   3. Anchor bolts shall have a minimum diameter of 1/2-inch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation of the gates and appurtenances shall be done in a workmanlike manner. It shall be the responsibility of the CONTRACTOR to handle, store and install the equipment specified in this Section in strict accordance with the manufacturer's recommendations.

B. The CONTRACTOR shall review the installation drawings and installation instruction prior to installing the gates.

C. The gate assemblies shall be installed in a true vertical plane, square and plumb.

D. The CONTRACTOR shall fill the void in between the gate frame and the wall with non-shrink grout as shown on the installation drawing and in accordance with the manufacturer's recommendations.

3.2 FIELD TESTING

A. After installation, all gates shall be field tested in the presence of the OWNER to ensure that all items of equipment are in full compliance with this Section. Each gate shall be cycled to confirm that they operate without binding, scraping, or distorting. The effort to open and close manual operators shall be measured, and shall not exceed the maximum operating effort specified above.

END OF SECTION